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984F
U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

586

RECEIVED

Issued June 3, 1914; revised July, 1929.

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COLLECTION AND PRESERVATION OF PLANT MATERIAL
FOR USE IN THE STUDY OF AGRICULTURE.

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INTRODUCTION.

The purpose of this bulletin is to suggest methods of collecting, preparing, mounting, and preserving plant specimens of various sorts which can be used by teachers of agriculture. To instructors in agriculture who have had special training along these lines, doubtless many of the suggestions here given will seem superfluous; but there are many teachers who are called upon to teach agriculture who have not had such training, and who will doubtless welcome specific information as to how to prepare the materials needed for illustration and demonstration purposes in the classroom.

WHAT MATERIALS SHOULD BE COLLECTED.

The nature of the materials which the teacher should collect will depend, of course, upon the character of the school and the class of work which is taken up by the pupils, as well as upon the locality, the funds available, and the time which the pupils and teacher can devote to the work.

In general, the illustrative materials with which every school should be provided may be grouped into two classes, according to the uses to which they are to be put: (1) Museum specimens and samples, which are to be kept permanently for reference, display, and strictly illustrative purposes only; and (2) working collections, which may be used for display and illustration but the chief purpose of which is to supply the pupils with materials for class study and experimental use. For instructional purposes, the latter group is by far the more valuable, but a permanent collection of specimens and samples of various seeds, plants, and other materials may be very useful to any school, provided, of course, the specimens are accurately labeled and so preserved and mounted that they are readily available for examination.

Materials for class use should, as far as possible, be fresh and in the natural state, rather than dried or preserved, and should, therefore, generally be collected just prior to the time they are wanted and put away only temporarily. No great degree of care or skill will, in general, be necessary to do this. But for a permanent collection in a school museum considerable technical knowledge and ingenuity are often required in preparing and preserving the specimens and preparing convenient receptacles in which to keep them. This is particularly true where the means at hand are limited and the resourcefulness of the teacher must be relied upon to produce inexpensive methods and devices of home manufacture.

SOURCES OF MATERIALS.

In recent years, many commercial houses, educational institutions, and Government bureaus have made a practice of distributing collections of specimens and samples of various sorts to schools. Such collections are of great value, undoubtedly, and there is no objection whatsoever to schools securing materials from such sources whenever possible, so long as they do not rely upon these sources for all their illustrative material. But it is a much better practice to have the pupils collect and prepare their own materials as far as possible from original local sources, because of the educational possibilities involved in the process of gathering the various specimens.

Almost any locality affords supplies of seed, plant, and wood specimens, and other materials of vital importance in the study of agriculture; and the work of gathering these specimens will afford definite tasks upon which to center the interest of numerous field trips, so that the danger of aimless wandering which so frequently makes this method of instruction devoid of practical results may be minimized. The instructor who takes his class out into the field with the definite purpose of collecting specimens of weed seeds, for example, has the very best possible opportunity at the same time to teach not only identification of the local weed species but also useful facts as to their relations to soil and climate.

GENERAL SUGGESTIONS FOR FIELD WORK.

It is important that complete and accurate records should be kept for each specimen collected in order to supply the data necessary for the proper labeling of the mounted specimen. Sometimes, as in the case of wood specimens, it will be necessary to mark each sample in the field, as soon as it is obtained, with the name of the tree from which it is taken, in order to prevent mistakes in naming the mounted specimens. It should be the aim of the instructor to

make the fieldwork teach something besides mere methods of collecting, and, with this in view, the pupils should also be provided with notebooks and pencils for making memoranda of things learned on the trip.

All work of this sort should be constructive and never destructive. Indiscriminate picking or digging of wild flowers or unnecessary cutting of branches of trees should not be permitted. Whenever it is necessary to obtain a specimen of a desirable plant or wood, that plant should be taken which can be best spared, if there is any choice. If a branch must be cut from a tree, see that when it is done the tree will be the better off for the pruning.

SUGGESTIONS CONCERNING THE ARRANGEMENT OF MATERIALS.

When plants or other materials are collected for ordinary purposes of study and reference, it will generally suffice to arrange the specimens in their logical order, according to their scientific classifications. When, however, it is intended to prepare a set of specimens for an educational display, very interesting and attractive groups can be arranged to show strikingly the agricultural relationships of the particular plants in question. For example, a display centered about some particular agricultural crop plant might show the different types or varieties of the plant itself; the commercial products manufactured from it; the enemies, such as insects and plant diseases, from whose attacks it needs protection; and pictures showing methods of cultivating and harvesting the crop. A display might be centered about some farm insect pest so as to show the insect in the various stages of its development; specimens of the plant upon which it feeds, showing the injury it does to these plants; specimens of other insects which are hostile to it; and pictures of birds which prey upon it. Exhibits such as these take time to prepare, but they will prove enough more attractive than an ordinary collection to warrant the extra labor and thought involved in their preparation.

COLLECTION OF PLANT SPECIMENS.

WHAT PLANTS TO COLLECT.

In the collection of plant specimens for use in the agriculture class it will be obvious that plants of purely botanical interest need not be included. In general, the plants which should be collected may be divided into two groups: (1) Plants of value to the farmer, both cultivated and wild; and (2) noxious plants or weeds. As a subclass of the noxious plants, special attention should be given to poisonous plants, with a view to making the pupils familiar with them so as to

prevent personal injury from poisoning as well as to enable them to take proper steps for the eradication of these particularly undesirable members of the weed class.

HOW TO COLLECT.

When starting out to collect specimens it will be necessary for the pupil to be provided with some sort of receptacle in which to carry the specimens. For collecting material for immediate study the best receptacle is undoubtedly a tin botanical specimen case such as may be purchased from any school-supply house. Specimens collected for permanent preservation may be prepared most satisfactorily by taking into the field a press such as is shown in figure 1 and placing the plants between the driers as they are collected. Fresh plants can be arranged more easily upon the sheets than can the more or less wilted or bruised specimens collected in a can or case.

In collecting specimens of the smaller plants it will generally be desirable to secure them roots and all, since many of the grasses and sedges can be best identified when the root systems are available for examination. With many of the flowering plants, however, it will be neither necessary nor desirable that the roots be taken up, since to do so would increase the possibility of exterminating desirable species, and the roots, in many cases, will not be essential to the study of the plant.

Unlike the collection of specimens for botanical use, the collection of plants for study in connection with agricultural work generally necessitates the identification of the plant in the field; otherwise the pupils can not know whether or not the species in question is of any importance agriculturally. Assuming, then, that the identity of the plant is known, it will be obvious that later possibility of confusion of identity should be guarded against by properly labeling each specimen as it is collected. For this reason before going into the field it will be well to provide a quantity of labels with strings attached to them, so that one of these may be readily tied to each plant as it is gathered. This label should remain constantly attached to the specimen while it is being pressed and until it is finally mounted in permanent form.

HOW TO PREPARE PLANT SPECIMENS FOR MOUNTING.

Most of the specimens of plants obtained for agricultural study will have to be pressed in order to prepare them for final mounting. Various devices may be adapted for use in pressing plants, some of which will be familiar to all teachers of botany or agriculture. Specially prepared driers on sale at botanical supply houses are best for this use. Carpet felt is sometimes used, but this is generally not sufficiently absorbent. A good substitute for the specially prepared driers are several thicknesses of ordinary newspaper (not magazine

paper with smooth surface). The newspaper may be cut to the size of the driers and five to ten sheets fastened together. The driers should be changed twice each day for the first two days, and once

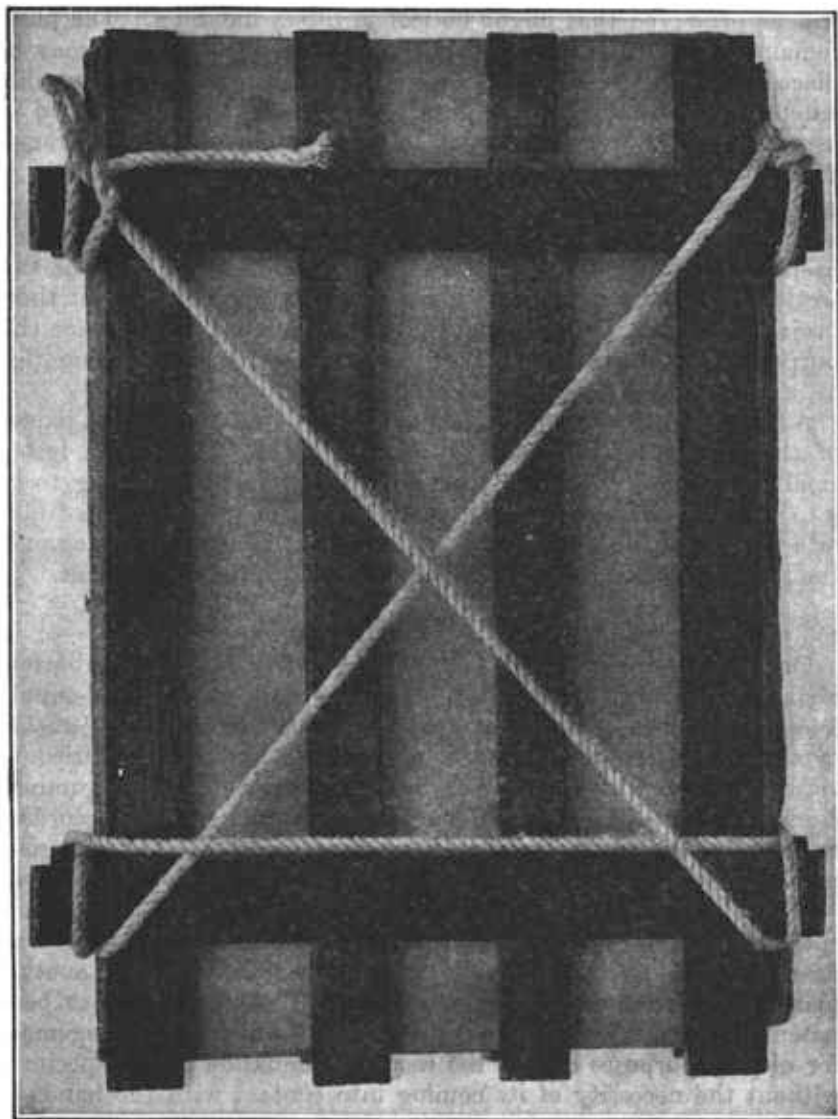


FIG. 1.—Home-made plant press, showing method of arranging rope to get greatest pressure.

each day for a week thereafter, to give the best results. It is advisable to place the specimen between a folded sheet (standard size) of stock newspaper (or printed newspaper). The plant with its

folder is transferred from wet driers to dry ones when changing them. If this is done properly the specimens will not be handled directly, delicate plants will be saved from injury, parts will not be disarticulated, and such parts as leaves, flowers, fruits, and seeds will be preserved that might be lost in direct handling. The plant remains within its folder until ready to mount. A number may be placed upon the sheet ("inner sheet") and the corresponding number entered in a notebook with data. Instead of the old method of using weights, a very good plan is to use a set of pressing frames such as those shown in figure 1. These frames may be made of strips $\frac{1}{2}$ inch thick, $1\frac{1}{2}$ inches wide, and 18 inches long. Each frame is 12 inches wide, the crosspieces being 14 inches long, so that they project 1 inch beyond the edge on each side, in order that the two sections may be easily bound together by passing cords about these projecting ends. Ordinary cotton clothesline may be used for this purpose. By adjusting the cord as shown in the illustration (fig. 1), a considerable pressure can be secured with little effort.

A frame of this size is necessary in order to contain pressing papers of the standard size used by botanists (12 by 17 inches), but a smaller size may be used if desired. If a plant is too long to go into the press, it may be bent in the shape of a "V" or an "N"; or a portion of the stem at the base may be discarded, showing only the roots and basal leaves and the upper two-thirds of the plant.

MOUNTING.

Ordinarily, dried plant specimens are best kept in herbarium books such as may be obtained, in various sizes, from school-supply houses. The herbarium sheet used by botanists is $11\frac{1}{2}$ by $16\frac{1}{2}$ inches in size, and the plant, after being properly pressed and dried, is either glued to the sheet or fastened to it with slips of gummed cloth or paper. The mounted specimens are then grouped according to genera, each genus being inclosed in a separate cover of strong manila paper.

Where it is desired to arrange the plant specimens so that each specimen may be constantly displayed, or where specimens such as heads of grain, which can not be pressed, are to be mounted, another plan must be followed. For use in such cases a device has been patented which affords the advantage of an attractive arrangement for display purposes and of the ready examination of the specimen without the necessity of its coming into contact with the hands of the observer. The plan followed is to mount the specimen on cotton in a box having a glass cover and a loose back which may be fastened down tightly upon the cotton so as to hold the specimen embedded in the cotton against the glass, through which it may be examined. The object to be mounted is placed in the mount upon the glass face down; upon it are placed layers of cotton batting so as to fill the box completely (fig. 2), the back is then put on and fastened down

tightly upon the cotton, thus holding the object securely in place against the glass front (fig. 3). Glass-covered mounting boxes, like that described, generally made of heavy cardboard, can be purchased in various sizes from supply houses.

A few plant specimens, such as some of the fleshy fruits or roots of leguminous plants showing nodules, can not be satisfactorily preserved by drying. Such specimens may be preserved in glass jars in preservative fluids. A large-mouthed receptacle of some sort is required for this purpose. The best kind is, of course, the square

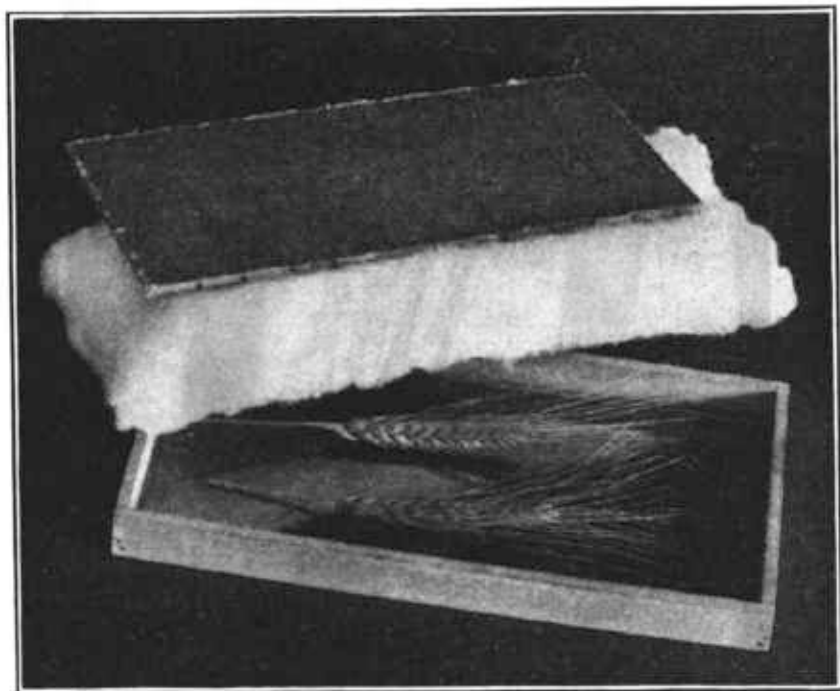


FIG. 2.—Method of mounting heads of grain under glass.

museum jar, but lacking this the next best thing is an ordinary fruit jar. Delicate specimens of this sort must be carefully protected in the field, when being collected, from excessive drying or bruising. This can be done by wrapping each specimen separately in pieces of moist newspaper. Specimens of roots and similar articles should be carefully washed before mounting. An old toothbrush will be found to be an excellent thing for this purpose, since by its use particles of dirt which would otherwise be hard to get at can be easily removed. After being washed the specimen may be placed in a 2 or 3 per cent solution of formalin (using formalin with a strength of 40 per cent



FIG. 3.—Heads of grain mounted under glass.

formaldehyde) for several days, after which it should be placed in a jar containing a 5 per cent solution of formalin. A simple method of arranging a delicate plant so that it shows well in the jar is to attach a fine thread to the specimen and suspend it thus in the fluid. By holding the end of the thread in the left hand while the cover of the jar is put on, the thread may be fastened so as to hold the specimen in any position desired.

PRESERVING MOUNTED SPECIMENS.

Specimens mounted in fluids, as last described, will, of course, need no protection from insects or mice. But herbarium specimens and those mounted in frames under glass will be subject to such attack and should be protected. A good plan is to place in the herbarium case or mounting frames a few ordinary moth balls or a few naphthalin flakes. These will generally suffice to keep out injurious insects.

COLLECTION OF SEEDS AND GRAINS.

WHAT SEEDS TO COLLECT.

This collection should include seeds of plants similar in character to those suggested for collection as plant specimens. One of the first collections to be made should be samples of the seeds of local weeds, especially those weed seeds likely to be found mixed with farm seeds such as clover or small grains and difficult to distinguish from them. Careful study of such weed seeds will help the pupils to detect adulterations and impurities of commercial seeds. Another collection should be made of the seeds of various crop-producing plants, showing different species and types. Care of course must be taken to see that these samples are pure and true to type if they are to be of any help.

HOW TO COLLECT SEEDS.

A good plan for collecting seeds in the field is to place the seeds, as gathered, in ordinary paper envelopes, writing upon each envelope the name of the plant from which the sample is taken, with such other data as may be desired, such as the date, locality, etc. Small cloth bags, such as those in which salt is sold, may be used instead of envelopes, if desired, and they are less likely to become torn. If the cloth bags are used, a slip of paper on which is written the necessary data concerning each specimen should go into each bag with the seeds. It will also be found convenient to take along a botanical collecting case, hand satchel, or a box of some sort in which to carry the envelopes or bags containing the samples of seed.



FIG. 4.—Permanent collection of farm seeds for school use.

HOW TO PREPARE SEEDS FOR MOUNTING.

All seed specimens should be carefully cleaned of chaff and impurities before they are put into the receptacles in which they are to be finally kept. After being cleaned they should be treated with carbon bisulphid or with formaldehyde, in order to kill any injurious insects or larvæ which may be concealed in or upon them. This can be done by placing the seed in a receptacle and pouring upon a



FIG. 5.—Students' collection of farm seeds.

piece of cotton placed on a saucer in this receptacle enough of the carbon bisulphid or formaldehyde to thoroughly wet the cotton, then closing the cover of the receptacle tightly so as to keep in the fumes. Great care should be taken not to use the carbon bisulphid near a fire, or to strike a match while it is being used, since it is very inflammable and may explode if not properly handled. The fumes of both carbon bisulphid and formaldehyde are very disagreeable and inhaling them should be avoided.

MOUNTING AND STORING SEED SAMPLES.

There are numerous methods by which seeds may be stored for use. The best method will depend upon the purpose for which the samples are to be used and the quantity of seed.

One of the simplest and most convenient methods of mounting samples of small seeds for study and display is to place the samples in small glass vials of 2 or 3 dram size, these vials being then placed in a strong cardboard box arranged with a separate compartment for each vial (fig. 4). Vials with screw tops are better for this purpose than those with ordinary corks, since they protect the seeds

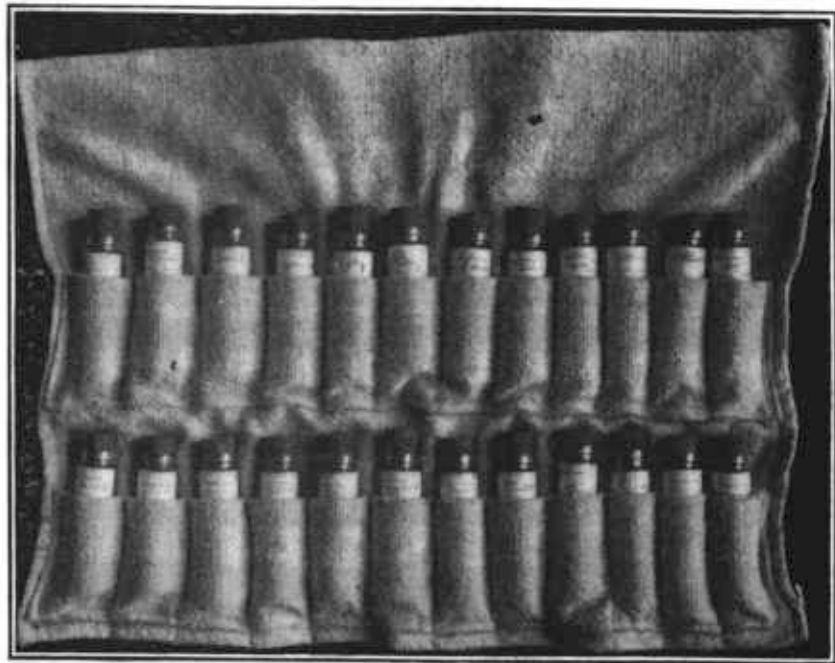


FIG. 6.—Cloth case for carrying samples of farm seeds in vials.

more securely from insects. The vials should be labeled, each with the name of the kind of seed it contains, the place and date of collection, and any other data desired.

If the cardboard box with compartments as suggested can not be obtained, simple holders or cases of various kinds can easily be made which will serve the purpose very well. One such holder is indicated in figure 5. In this the vials are held in place by means of shoe laces passed alternately over, then under, the vials and through the back of the box. Another holder which is especially convenient for use in carrying vials of this sort from place to place, but not so satisfac-

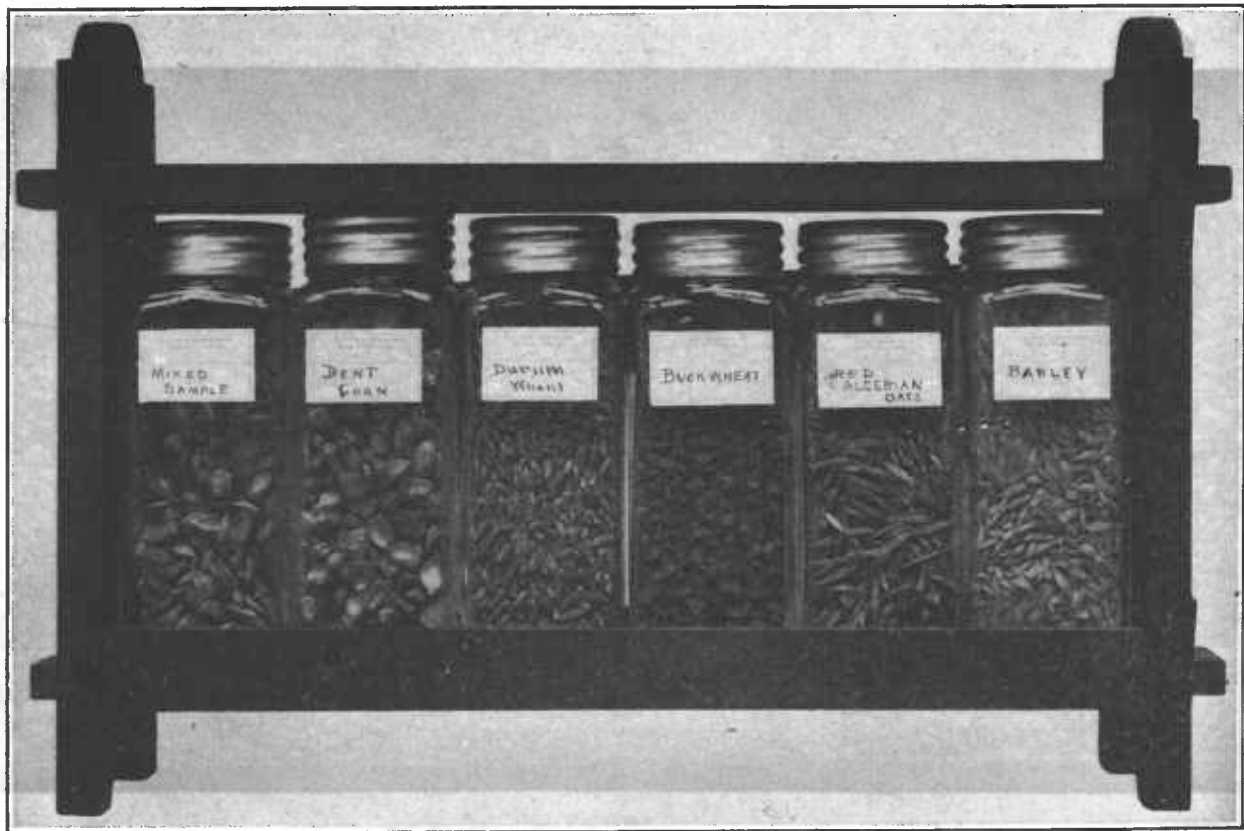


FIG. 7.—Rack for displaying samples of farm seeds.

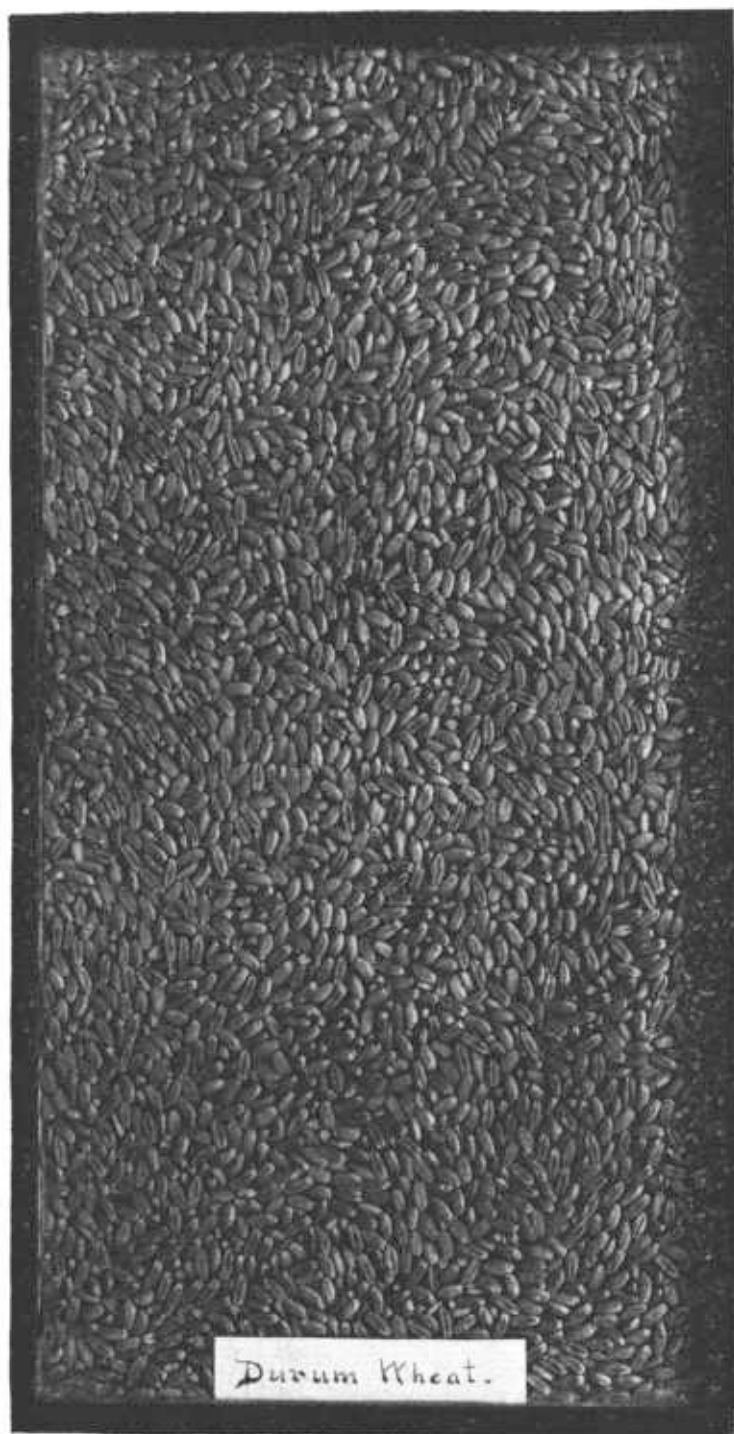


FIG. 8.—Sample of wheat displayed in glass-covered box.

tory for displaying them, can be made of cloth, as shown in figure 6. In this holder strips are sewed upon a rectangular piece of cloth so as to form rows of pockets, each pocket being just large enough to receive one of the vials containing the seed samples.

When it is desired to preserve larger quantities of seeds for future study or grains for experimental planting, larger glass bottles or jars

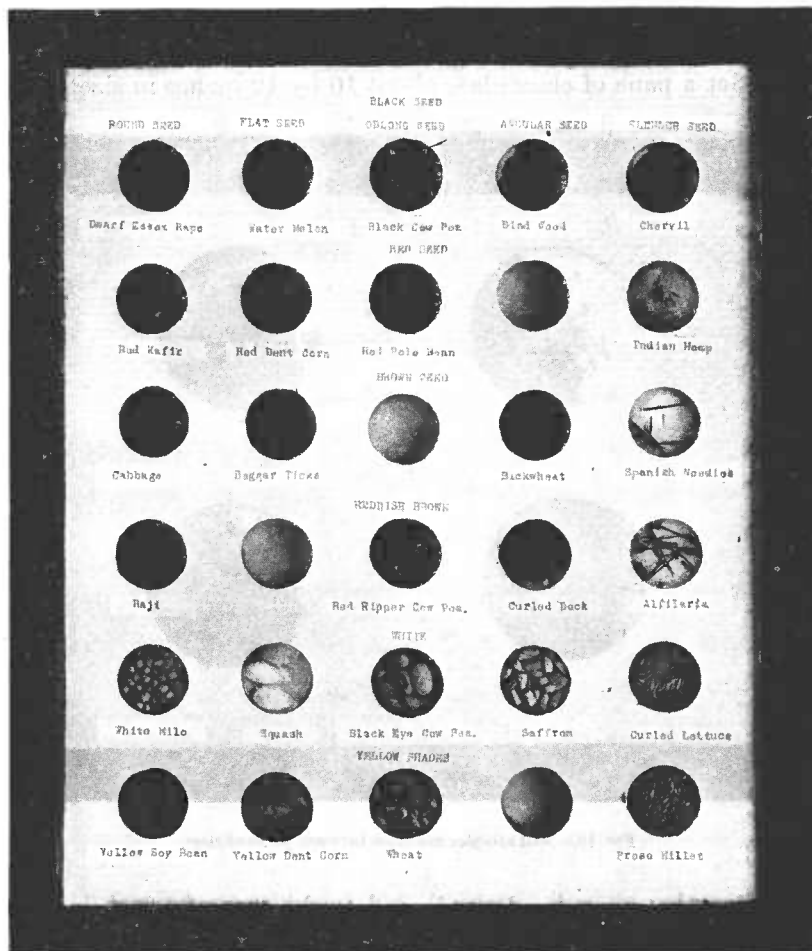


FIG. 9.—Simple method of making a seed-identification chart.

with screw tops or ordinary fruit jars may be used. Of the different kinds of fruit jars those with glass tops which seal with wires will probably be best. But the square glass bottles take up less space (fig. 7). The rack shown in figure 7 is convenient for holding these jars, but they may be placed upon tables or shelves if desired.

Another good scheme for making attractive displays of seeds and grains is to place the samples under glass in boxes like that shown in figure 8. Such a plan has also the advantage of affording good opportunity for the close examination of the sample without the necessity of handling it. The boxes for this purpose may be made in the manner described below.

When only small quantities of seeds are available for mounting, and it is desired to display the samples to better advantage than by the use of vials, a convenient mounting rack is easily made as follows: Get a pane of clear glass about 10 by 12 inches in size (or any

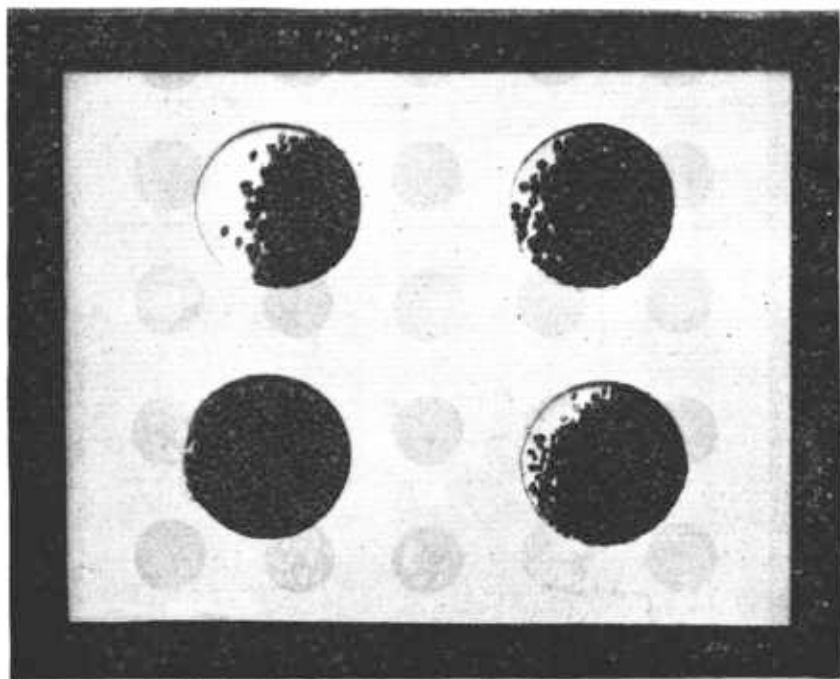


FIG. 10.—Seed samples mounted between panes of glass.

other size that may be desired) and two pieces of $\frac{1}{2}$ -inch board of some soft light wood, such as poplar or basswood, of the same dimensions as the pane of glass or slightly larger. On one of these boards rule lines both ways, spacing them about $1\frac{1}{2}$ inches apart. At each of the intersections of these lines bore 1-inch holes through the board. Now nail or glue this board to the other one. Each of the holes in the upper board will then form a pocket, in which a sample of seed or grain may be placed. A label with the name of the kind of seed and the place and date of collection should be pasted beneath each pocket. By arranging them in a form and color series,

as shown in figure 9, comparison and identification are facilitated. The pane of glass should now be put on to form a cover for all the pockets, thus holding the seeds securely in place. The glass may be held tightly over the pockets by placing the whole mount in an ordinary picture frame and fastening it in with small nails. In the case of small seeds, sheets of heavy cardboard may be substituted for the pieces of board, and the cardboard and glass may be held together by binding the edges with gummed paper, such as the ordinary passe-partout binding, instead of putting the mount into a frame (fig. 10). By using smaller panes of glass, such as discarded photographic

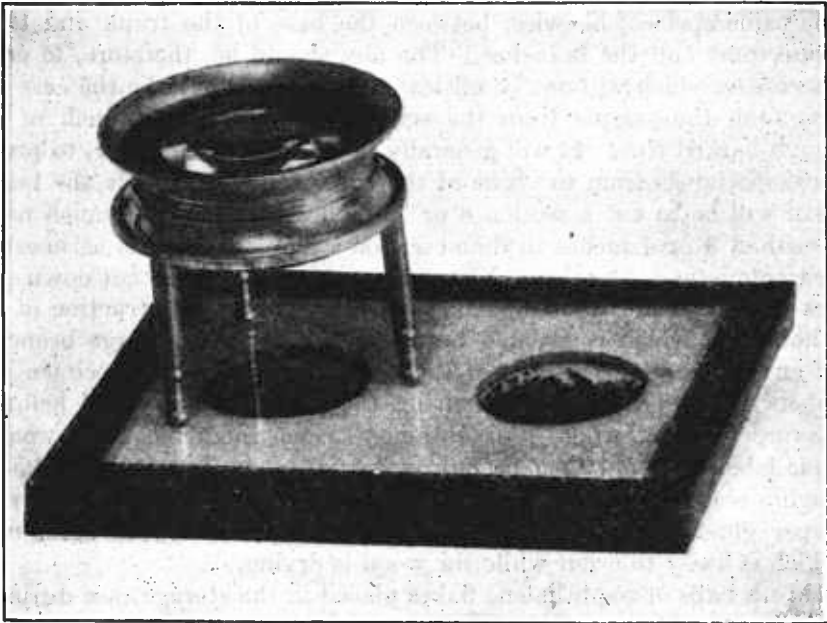


FIG. 11.—Using the microscope to study seed samples.

plates, numerous small mounts may be made which may be easily handed about in the class. This method of mounting has another great advantage in that when mounted in this way the seeds may be easily examined under a microscope (fig. 11).

PRESERVING SEED SPECIMENS.

Seeds treated as previously directed and mounted in tightly closed vials, jars, or in the tight frames described will not be very likely to suffer damage from insects or other sources. As a further precaution, however, in the case of jars that are opened frequently, it may be well to drop into each receptacle a few moth balls. This will prevent insect attack for some time.

COLLECTION OF WOOD SPECIMENS.¹**HOW TO COLLECT.**

The best time to collect wood specimens is in the autumn, when the fruit is more or less mature and the leaves have not yet fallen, for the leaves and fruit are often important aids in determining the identity of the trees, and the wood at this season contains less moisture than earlier in the season.

The specimen should, as far as possible, display features of bark and wood that will be characteristic of the tree from which it is taken. It is important to note that there is much difference in the appearance of the bark between the young tree and the old one of the same species; likewise, between the base of the trunk and the upper part and the branches. The aim should be, therefore, to get specimens which will not be misleading, such as would be the case if one took the sample from the smooth-barked young branch of a rough-barked tree. It will generally be impossible, however, to procure specimens from the base of the tree trunk. Probably the best plan will be to cut a section 8 or 10 inches long from a branch not less than 3 or 4 inches in diameter, on which the bark is as nearly characteristic as possible. Young trees should never be cut down to get sections from the trunk, for to do so entails the destruction of a whole tree, which is avoided by taking a section of a large branch of an old tree. The name of the tree from which the specimen is taken should be plainly written on the wood with a pencil before leaving the spot where it is obtained. The rough blocks of wood thus labeled should then be put away and allowed to become thoroughly seasoned before anything further is done with them. Heavy paper glued over the ends of the block will lessen the checking which is likely to occur while the wood is drying.

Moth balls or naphthalene flakes placed in the storage case during this period will help to prevent damage by insects which often bore between the bark and wood. Should this prove ineffective, it would be advisable to keep the specimen two or three days in an air-tight container in which a dish of carbon bisulphid has been placed. An ordinary galvanized ash can, which may be sealed by pasting paper around the edge of the cover, serves the purpose admirably. Should the finished specimens be attacked by insects, the treatment should be repeated.

PREPARING AND MOUNTING WOOD SPECIMENS.

When the blocks of wood have become thoroughly seasoned they may be finished off in any shape or manner that may be desired. Perhaps the best way is to split off one side of the block to a depth equal to about one-third of its diameter, which will show the grain

¹ Revised in the Office of Forest Pathology, Bureau of Plant Industry.

of the wood. In certain species it would be advantageous to smooth off in addition a surface which passes through the center of the block, in order to show the quarter-sawed effect. One end of the block may then be cut squarely across and the other may be sloped at an angle of about 45° from the bark-covered surface out to the flat face (fig. 12). In the square-cut end a small screw eye may be

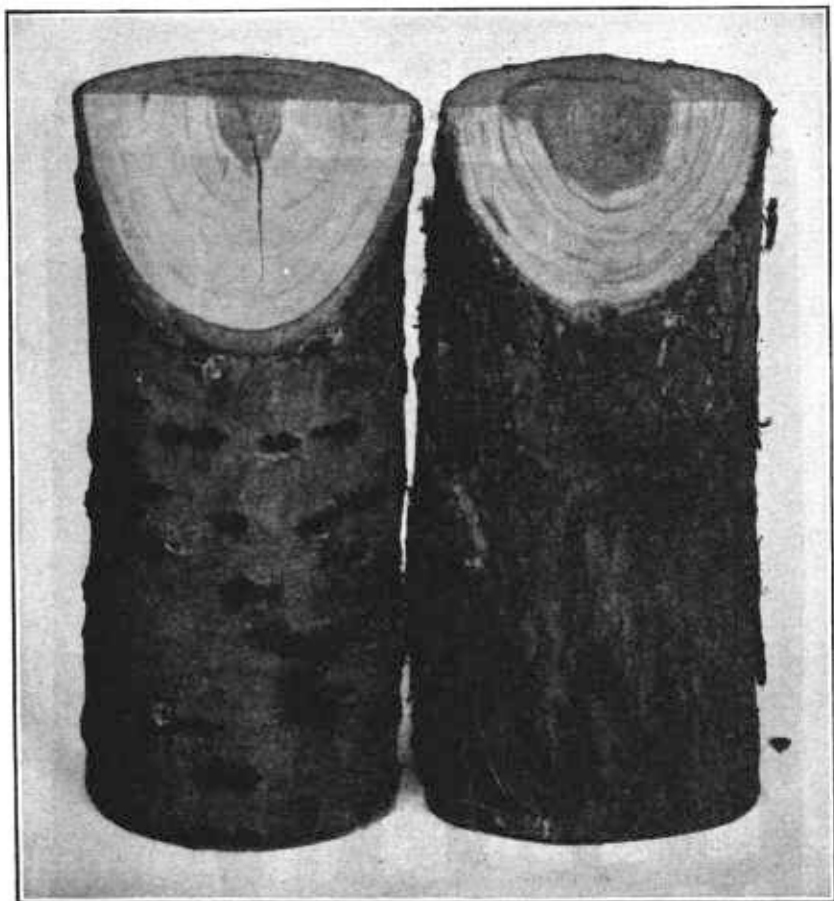


FIG. 12.—Wood specimens prepared for study.

inserted and the block may then be hung, with the others similarly prepared, on nails or hooks in a strip of molding on the wall or in a cabinet. Wood specimens prepared in this way can be taken down for examination, and may be conveniently packed when it is desired to move them from place to place. A label bearing the scientific name and the common name of the species, the date and place of collection, and other data should be attached to each specimen.

Another method of mounting wood specimens is shown in figure 13. In this case, both ends of the blocks are cut squarely across and a piece is split off one side so as to show the grain of the wood. The blocks are then placed in racks, as shown in the illustration, and are fastened in place by small nails driven into the tops and bottoms through the boards of the rack.

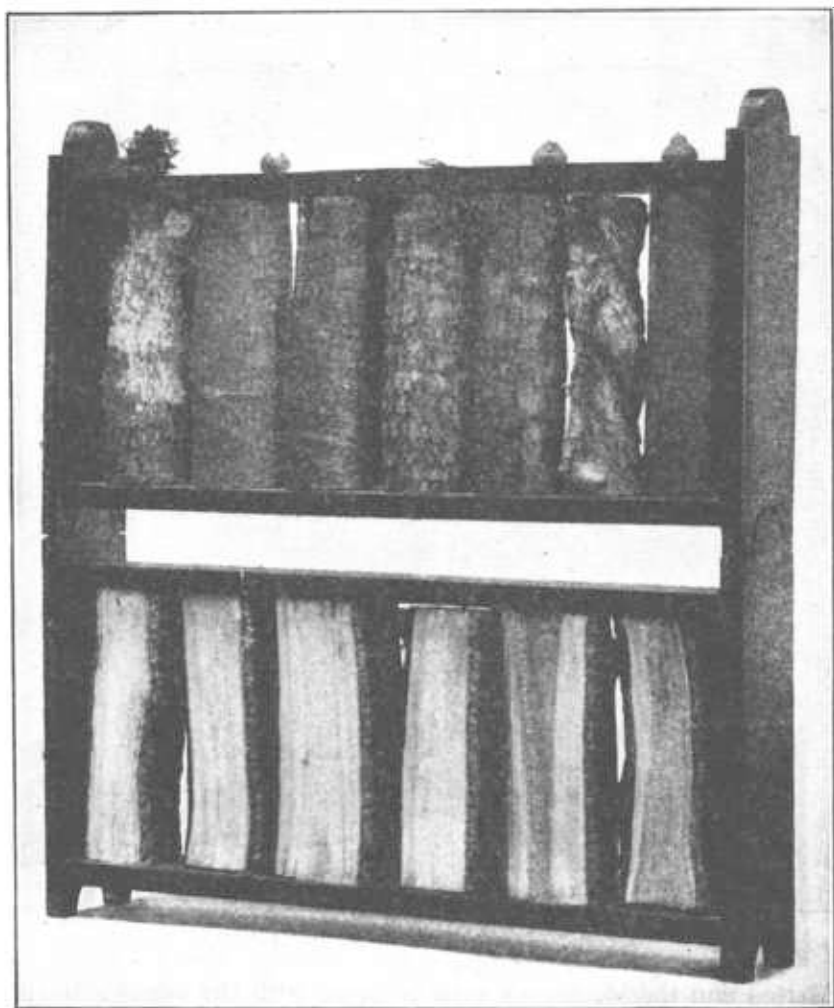


FIG. 13.—Method of mounting wood specimens in racks.

These mounting racks are made of one-half inch materials, as wide as the specimen blocks are thick. The end uprights are cut so that one rack may be placed upon another, leaving spaces between in which may be placed specimens of the fruit of each species of tree represented by the wood specimens, if so desired (fig. 13).

In preparing the wood specimens it is a good plan to smooth off the split or sawed surfaces by scraping them with the sharp edge of a piece of glass, then sandpapering them well. An application of linseed oil will help to prevent possible cracking of the wood, and will also bring out the colors and grain of the wood more clearly. A coat of colorless varnish may be applied if desired to give the specimens a still more "finished" appearance.

THE COLLECTION OF FUNGI.¹

WHAT FUNGI TO COLLECT.

Although practically all fungi are of some interest or importance in the study of agriculture, the group is so large and diverse that for ordinary teaching purposes only the larger and more conspicuous forms need be considered. The fungi may be treated as of two groups, one the parasites, or those forms growing on living plants or animals, and second, the saprophytes, or those growing on dead or decaying organic matter. Examples of the former group are the rusts, smuts, powdery mildews, and species causing leaf spots, fruit rots, and stem and branch cankers.³ In the latter group are included the mushrooms, puffballs, coral fungi, and the wide range of bracket fungi and other types found on dead and rotting wood.⁴

METHODS OF COLLECTING AND PRESERVING FUNGI.

Fungi differ greatly in size ranging from minute, often microscopic, species to those of considerable size, such as the large bracket fungi a foot or more across. Similarly, in texture there is a wide range from the fleshy or gelatinous forms to the leathery or woody types. To obtain and preserve such diverse material presents some difficulties, and it must be recognized that the general methods outlined here often will not be suitable for many species which will require special treatment.

For collecting purposes any sort of container may be used such as the standard botanist's tin collecting can or vasculum, or a leather traveling bag or a knapsack, as long as it serves the essential purpose of keeping the specimens from bruising or breaking in transit or from other unfavorable changes. Once the specimens are collected, there should be as little delay as possible in preserving them, since fleshy forms decay rapidly or are destroyed by insects and the more fragile species break down or otherwise lose their diagnostic characters.

¹ Prepared in the Office of Mycology and Disease Survey, Bureau of Plant Industry.

³ For a detailed list of the parasitic fungi of economic importance in the United States, see the following publication, which may well serve as a guide in collecting fungi of this nature: ANDERSON, P. J., HASKELL, R. J., MUENSCHER, W. C., WELD, C. J., WOOD, J. I., and MARTIN, G. H. CHECK LIST OF DISEASES OF ECONOMIC PLANTS IN THE UNITED STATES. U. S. Dept. Agr., Bul. 1366, 112 p., illus., 1926.

⁴ For further information as to fungi of this group, see the following publication: PATTERSON, F. W., and CHARLES, V. K. SOME COMMON EDIBLE AND POISONOUS MUSHROOMS. U. S. Dept. Agr., Farmers' Bul. 796, 24 p., illus., 1917.

It is particularly desirable in collecting fungi for demonstration or class use to see that the specimens taken are fully developed and in good fruiting condition. (A hand lens of about 10 diameters magnification will be found helpful in this connection.) A portion of the host or substratum should also be retained, in order that the effect of the fungus on the host may be evident and the latter properly identified. A collection should consist of sufficient material to show the variation of the species in size, color, or other distinguishing points.

Fleshy or leathery fungi of all sizes are usually placed as collected in envelopes or paper bags, keeping the individual collections separate both for a matter of record and to prevent mixing of spores which would cause confusion when identification is attempted. Cardboard boxes, small tin cans, or wide-mouth bottles can also be used to advantage for many fleshy fungi to prevent breaking. These individual containers are, of course, carried in the vasculum or other collecting case.

Fungi on leaves, roots, twigs, and herbaceous stems can be handled temporarily as above indicated and then transferred as soon as convenient to a plant press such as is described on page 6, or they may be placed directly in the press if it is found possible to carry it in the field. In either case care should be used to keep individual collections separate as noted above. The plant press can also be used for drying the smaller woody or fleshy fungi and even some of the larger species by slicing the fruiting bodies to convenient size.

At the time of collecting the specimens all necessary data should be recorded either in a field notebook, numbering the specimens, or on a label placed with the specimen. Desirable data include substratum or host, locality and date, name of collector, and collection number. While it is not at all necessary to number the specimens, such a system has distinct advantages through greater ease in keeping records, particularly if duplicate material is involved or if portions of the collections are to be sent to specialists for identification.

Fleshy or woody specimens that can not be handled through the use of a plant press for final preservation may be dried in some cases in bright sunlight if the humidity is sufficiently low. More uniform results will be obtained, however, by the use of an oven. Ovens of the type used over kerosene stoves are very useful for this purpose. Where a thermostat-controlled oven on a gas or electric range is available excellent results are obtained by using a temperature of 200° to 300° F., using the lower temperature at first for the more watery forms. Secondary drying temperatures, often necessary when specimens reabsorb moisture after a preliminary drying, may run as high as 400° F. if care is used to prevent scorching. Improvised ovens of various sorts over camp fires or lanterns can also be made to serve the purpose. Under all circumstances care should be used

to avoid scorching, which destroys the characteristics of the fungi involved. A further caution is necessary concerning oven-dried material, in that it is very brittle and liable to injury by breaking.

It will be found helpful to make spore prints of mushrooms and some of the other larger fungi. These are made by placing the freshly gathered specimens with the sporulating surface downward on a sheet of paper of contrasting color from the specimen itself, or upon a piece of glass, and covering them with a glass jar. Within a few hours a deposit of spores will be made showing the characteristic spore color and spore ejection pattern. Spore prints may be placed in an envelope and filed with the specimen, or if on glass they may be mounted as described for fungus specimens. In either case the print can be made more permanent by spraying it with an emulsion of gum arabic such as is used for preserving charcoal drawings.

After the fungus specimens have been dried, arrangements must be made for permanently filing or displaying them. The mounting of specimens on herbarium sheets as described for flowering plants is not recommended, since it makes the study of the material difficult, although it may serve to some extent for demonstration purposes. Flat specimens may be placed in envelopes of any size desired and filed in drawers. The usual practice in mycological herbaria is to place the dried specimens in a paper packet of the proper size and to glue this to a herbarium sheet. Several specimens of the same species can be placed on one herbarium sheet. Larger specimens should be placed in cardboard boxes, which can be obtained in several sizes. These boxes may be filed in any desired manner, but the use of trays of herbarium size will be found most convenient. Material in bulk for class use may be stored in boxes, preferably tin, with tight covers to prevent insect or rodent infestation.

Flocculent fungi, the myxomycetes or slime molds in particular, are best preserved by placing bits of the material on drops of glue in the bottom of small boxes. Ordinary pill boxes serve the purpose very well. These boxes may be filed in envelopes or in larger boxes as units in the herbarium trays.

For demonstration purposes, particularly in the case of the rusts, smuts, and other economic parasitic forms, the use of the glass-covered boxes and cotton described on page 6 (fig. 2) is recommended. Another method, adapted to lichens and other fungi of similar nature, is as follows: Procure two small plates of glass of any size desired, such as discarded photographic plates which have been thoroughly cleaned. Fasten the specimen, face up, to one of these glass plates by means of a little glue. Upon this glass plate, around the edges, run a strip of wood or heavy cardboard, so as to make a sort of box deep enough to hold the specimens, gluing the lower edge of this strip to the glass on which the specimen is fastened. Then cover the upper

edge of the strip with glue and lay the other glass upon it, thus forming a closed box or case, its two sides being of glass. Now, bind the edges of this box with passe-partout binding paper (fig. 10). When specimens are mounted in this way it is possible to examine both their upper and lower surfaces, and the mount will last for years if carefully handled.

In a limited number of cases the pickling of specimens is advantageous, as, for instance, where the fungus is a parasite in plant tissues and it is desirable to prevent drying. In such cases the specimens are put directly into the liquid and the containers kept well stoppered. Regular museum jars may be obtained for the purpose, or any available glass containers may be pressed into service. Glass-topped fruit jars will prove satisfactory. Pickling liquids commonly used are formalin (1 part by volume of commercial formaldehyde solution to 9 parts of water), or 70 per cent alcohol (either grain or wood). In general, pickling is not advisable, since most pickled fungi deteriorate and become useless for either exhibition or study purposes.

Most of the fungi, the fleshy forms in particular, are subject to insect attack, necessitating constant vigilance to keep mounted specimens and boxed collections free of the pests. Naphthalene has some value as a repellant, but the use of an effective insecticide such as paradichlorobenzine is recommended. This material comes in the form of dry flakes and is noninjurious to specimens or those handling them.